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ABSTRACT

The planning technique or device, regardless of its degree of sophistication, is only a tool and cannot be substituted for effective managers. The planning process must be an integral part of the entire management process, which often evolves over many generations of trial and error. The function of planning and management entails the continuous, intelligent direction of others by determining and communicating the prime and supporting objectives of the program. This function necessarily includes the development and utilization of an integrated time-phased plan of action, demanding reasonable refinements in the way of resources, and the subsequent balancing of resources as they are made available and utilized. This paper develops and describes the management process as the foundation for utilizing planning techniques in program management. A brief, selected bibliography is provided. (Author)

PLANNING AND MANAGEMENT PROCESS

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PLANNING AND MANAGEMENT PROCESS

The planning technique or device, regardless of its degree of sophistication, is only a tool and cannot be substituted for effective managers. The planning process must be an integral part of the entire management process, which has often evolved over many generations of trial and error. Much has been written about the technique of educational planning, very little has been done to develop and describe an orderly process by which managers can go about getting things done. This paper develops and describes the management process as the foundation for utilizing planning technique in program management.

The function of planning and management entails the continuous, intelligent direction of others by determining and communicating the prime and supporting objectives of the program. This function necessarily includes the development and utilization of an integrated time-phased plan of action, demanding reasonable refinements in the way of resources and the subsequent balancing of resources as they are made available and utilized. The following steps are the representation of the common educational planning and management process today.

Step 1 - Define Educational Needs/Problems

Educational systems may be viewed as components of the larger socio-economic environment. Environmental recognition of the contribution

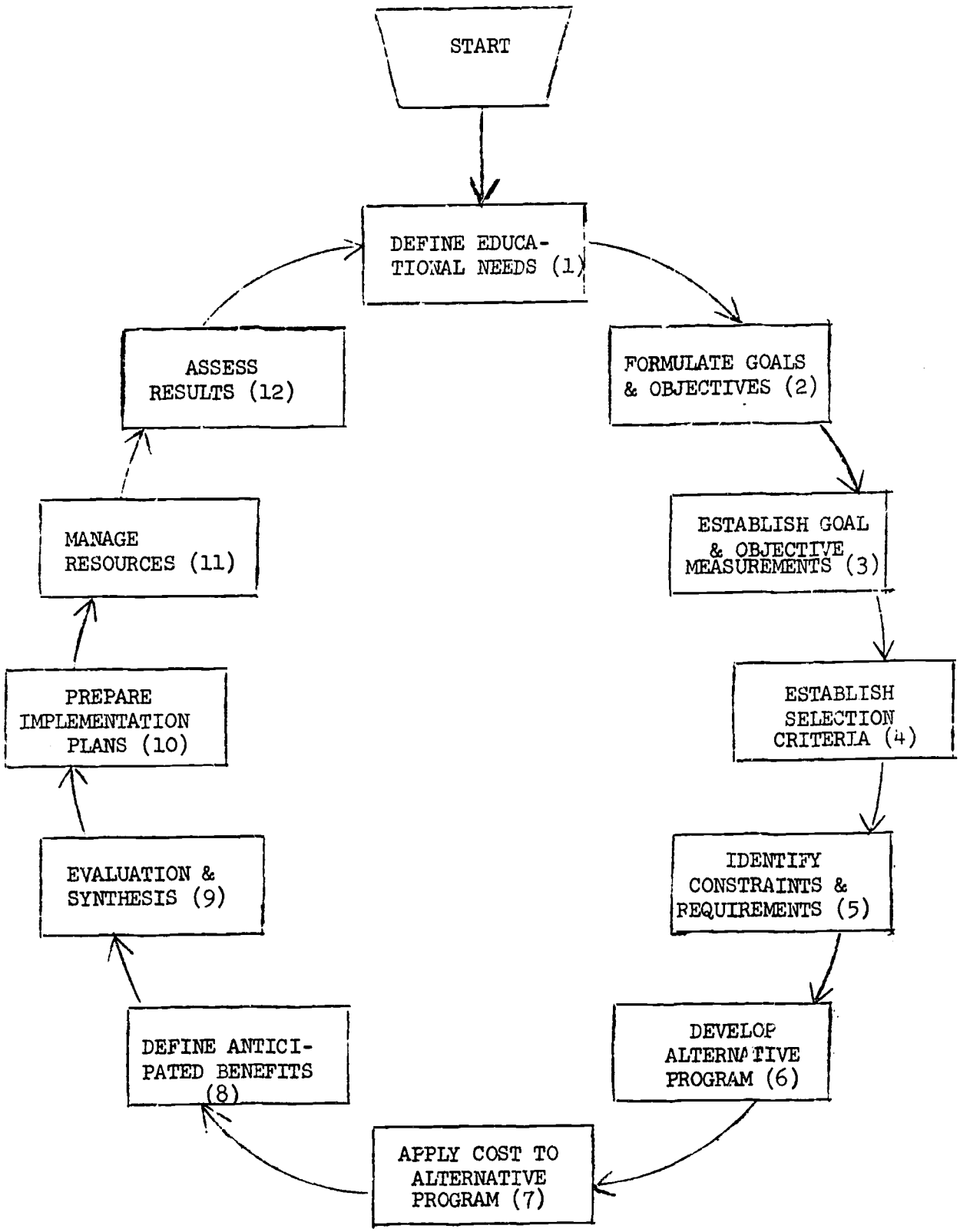

CHART 1: Educational Management Process

the educational component must make to this larger environment will lead to the identification of those areas where greater effort is required or to areas that may have been completely overlooked. These problem areas may be given general definitions, such as, "The need to increase citizen participation in a community." The emphasis in this step, however, should be directed toward defining the need rather than solving the problem, and should result in a listing of needs or problems of the environment ranked in order of priority.

Step 2 - Formulate Goals and Objectives

Goals should be stated in terms of how a plan meets the needs identified in Step 1. These goals should be ranked in order of priority and/or weighted. This is the most important statement of the goal structure and will constrain and guide all further development. Lower level goals which support and contribute to top level statements must also be identified, ranked and/or weighted. Ranking is the technique of comparing goals on the same level with each other to determine their order of importance. Weighting is a sophisticated method of assigning an arbitrary number of "weight" to a specific goal to depict the relative emphasis of that goal in relation to other goals on the same level. For example, ranking of Goals A through E on the first level may appear as shown below:

Goal	Ranking
A	4
B	3
C	5
D	1
E	2

That is, Goal D would be the most important of the five goals and Goal C the least important.

Weighting these same goals on a scale of 100 may appear as:

Goal	Rank	Weight
A	4	15
B	3	15
C	5	10
D	1	35
E	2	25
		100

The identification of goals, coupled with a concept of how these goals can be achieved, will lead to the identification of objectives. Objectives on the same level should be ranked and/or weighted in a priority order as described above in this step. Lower level objectives that support and contribute to higher level objectives should also be identified, ranked and/or weighted.

Step 3 - Establish Goal and Objectives Measurement

By definition, objectives must be quantifiable. Therefore, it is necessary to define the method by which the achievement of the objective can be assessed. These evaluative criteria should include data requirements and units of measure within a specified time frame.

Step 4 - Identify Overall Constraints and Requirements

The established goals and objectives should be reviewed to identify any possible limiting constraints and implied requirements. These constraints may be political, financial, demographic, social, technological,

or geographic. All identified constraints should be documented and related to their corresponding goal and objective.

Step 5 - Establish General Selection Criteria

To establish requirements which will assist in the evaluation of alternative programs, general selection criteria should be established for each element. Some criteria may apply to all elements. Some will be unique to a particular program. These selection criteria should be formally documented for each element.

Step 6 - Set Alternate Programs

Potential solutions to the educational requirements identified in the statement of goals and objectives must be developed in a program format and subsequently subjected to system analysis. This is a critical step. Choosing the better of two poor solutions may not meet program requirements. Hence, it may be necessary to create new program alternatives.

A detailed analysis of the program activities necessary to meet stated objectives should be documented, and total resource requirements identified. Elements common to most programs include personnel, materials, facilities, and services.

Step 7 - Apply Cost to Alternate Programs

The potential cost of each alternate program should be determined and documented. The procedure for applying cost to alternate programs

should be described. Particular attention must be directed toward identifying costs for the total program life.

Step 8 - Define Anticipated Benefits of Each Program

Benefits, the desirable outcomes of educational programs, can generally be measured in terms of the unit of measurement associated with the goal and objective. Determining the benefit value of alternate programs will provide a rational basis for the selection of programs.

An important consideration in the analysis of educational program benefits is the recognition and specification of who benefits and when.

Anticipated benefits which would be associated with each alternate program should be predicted in terms of the evaluative criteria of the objective.

Step 9 - Program Evaluation and Synthesis

The next step in planning is the comparison of the relative costs and benefits of alternate programs and, by discarding and/or synthesizing alternate programs, making the selection of the recommended programs.

Costs and benefits for each alternate program should be evaluated with respect to the following:

- Selection Criteria
- Overall Constraints and Requirements
- Goals/Objectives
- Relationship of Benefits to Costs

Step 10 - Prepare Implementation Plan

Once a program has been recommended and approved, a detailed implementation plan should be developed. This plan will include a time schedule for initiation of the program, assignment of required resources and responsible personnel.

Step 11 - Manage Resources

Once the program has been implemented, management action is required to ensure that the objectives are achieved on schedule and within the budgeted resources. It cannot be assumed that the costs and/or benefits will maintain the same value as in the initial analysis. If a particular objective has a short time frame, for example, time becomes more valuable as the end of the project approaches. The process for reallocation of resources is precisely the same as the process for initial allocation.

Step 12 - Assess Results

An essential factor in the planning process is the assessment of results. It is important to determine whether the recommended and the implemented program achieved the stated goals and objectives within the anticipated time frame and budget. The effectiveness of a given program can be assessed by comparing the actual performance with the planned or anticipated performance in terms of program accomplishments, resources expended, and time required.

Step 13 - Recycle Activities

If analysis indicates that the program has not achieved the desired results, the complete planning process can be repeated in view of existing facts. Further analysis may indicate the need for program revision or the development of an entirely new program. The milestones of the planning process are shown on Chart 2.

Within the last few years Operations Research has achieved the position of a new discipline in educational planning. Operations Research techniques have recently been applied to educational planning. Understanding this development is of special interest in transferring the techniques of Operations Research to those of educational planning. Two areas of Operations Research technique are most widely used in educational planning. These are planning with PERT-CPM and planning with mathematical programming.

PLANNING WITH PERT-CPM

The concept of PERT (Program Evaluation Review Technique) has proven to be a very valuable tool for schedule and cost control.

PERT is a set of principles, methods, and techniques for effective planning of objective-oriented work whereby a sound basis is established for effective scheduling, cost accounting, controlling and replanning in the management of programs.

STEP	FUNCTION	MILESTONE
1	Recognize and define educational needs	A statement of education needs in priority order
2	Formulate goals and objectives	A statement of the restated goals and objectives
3	Establish goal and objective measurement	A description of the established data, common, time, unit of measurement
4	Establish selection criteria	A statement of the criteria for selection and rejection of alternate programs
5	Identify overall constraints and requirements	A statement of overall constraints and requirements
6	Develop alternate programs and identify required program activities, time frames and resources	A description of alternative activities and resources required for each activity • Equipment • Personnel • Facilities • Materials
7	Apply cost to each alternative program	A statement of the cost of each program
8	Define anticipated benefits of alternative program	A statement of the benefits of each program
9	Program evaluation and synthesis	A statement of the result of the cost/benefit analysis
10	Prepare implementation plan	A statement of • Schedule • Personnel Assignment • Resource Assignment
11	Manage resources	A statement of monitoring program results
12	Assess results	A statement of final program results
13	Recycle steps	• Feed back to Step 1

CHART 2: Educational Planning Milestones

It employs:

- A product-oriented work breakdown structure, beginning with objectives subdivided into successively smaller end-items.
- A flow plan consisting of all the activities and events that must be completed or accomplished to reach the program's objectives. The planned sequence of accomplishment, interdependencies, and interrelationships is shown, this is called a network.
- Elapsed time estimates and identification of critical paths in the network.
- A schedule which attempts to balance the objectives, the network flow plan, and resource availability.
- Analysis of the interrelated networks, schedules and slack values as a basis for continuous evaluation of program status, forecast of overruns, and the identification of problem areas in time for management to take corrective action.

PERT cost utilizes the network structures as the common reference for estimating and controlling the cost as well as the schedule of the program. This feature permits more complete measurement of progress and enables managers to more realistically appraise the consequences of alternative courses of action.

The basic PERT technique is flexible enough to effectively encompass a variety of objectives and applications including allocation of resources to serve several concurrent projects. While some differences exist in nomenclature between PERT and CPM (Critical Path Method), which suggest conceptual differences, both use the network approach to develop and diagram plans, and both serve the same objectives effectively.

PERT provides a clear, concise report for top management's evaluation of the status of completed work, forecasting, and/or isolation of potential problems.

More precisely, PERT:

- Measures accomplishment agains current scheduled plans and objectives.
- Assists in identifying real time requirements and provides limits for detailed scheduling.
- Fixes responsibility and assures continuity of effort despite turnover in personnel, at either the executive or operational level.
- Provides disciplines which insure complete program coverage, avoids omission of important tasks at the outset of a program, and provides visibility from the total program objective down to the lowest supporting task.
- Spots potential problem areas in time for preventive action or improvement.

- Uses the management-by-exception principle in reporting to higher levels of management.
- Permits essential rescheduling and provides periodic evaluation of plans.
- Provides an opportunity for consideration of trade-offs in funds, manpower, performance, and time between critical and noncritical areas of effort as a means of improving schedule and cost situations for one or more programs.
- Makes it possible through its simulation techniques to evaluate and forecast outcome of alternate plans before implementation. Simulates and measures the effect of proposed changes in scheduled plans and permits an early identification of the most efficient plan when parallel approaches are used.
- Provides an historical data bank for the program which can be drawn upon for new programs.

PLANNING WITH MATHEMATICAL PROGRAMMING

Recently, Mathematical Programming techniques have also been used in educational planning. Mathematical Programming (not to be confused with computer programming) deals with resource allocation problems that contain a set of constraints expressed as linear equations with a

given objective function. The equations identifying the constraints of a given problem represent the limit upon the resources to be allocated, while the objective function either maximizes of minimizes values consistent with the specific constraints. The purpose of the objective function is to find the optimal solution to a problem within the specific constraints. Mathematical Programming implies decision under certainty, since a well defined outcome is the resulting solution. This type of model is deterministic in nature, but it also provides alternatives, some of which are feasible and appropriate for decision-making in a political atmosphere. That is, Mathematical Programming algorithm progresses toward the optimal feasible solution. For example, assume there are ten progressive solutions such that X_{10} is better than X_9; X_9 is better than X_8; etc. The optimal mathematical solution is X_{10}, but because of certain political constraints impossible to design into the mathematical model, X_6 is the most feasible solution.

Mathematical Programming by the "simplex method" was developed by George Dantzig in the 1950's to solve planning problems for the United States Air Force. The primary assumption for the technique is linearity among the variables. Since this requirement has imposed limitations in the development of linear equations for sets of variables, quadratic programming has recently emerged to facilitate solutions to non-linear problems. In its strictest definition, Mathematical Programming has limited application to educational problems, but through quadratic and heuristic

programming there exist new approaches toward solving some unwieldy educational problems. Heuristic programming suggests an aid to discovery or problem solving and implies that there are factors outside the Mathematical Programming model that assist in decision-making. Heuristic programming is not totally deterministic because of the external factors involved in selecting a feasible solution. However, as most problems in education are not solved in a strictly deterministic manner, and because of the political atmosphere surrounding educational problems, the heuristic approach with its feasible alternatives has broad application. Again, a feasible solution is not necessarily the optimal solution.

One of the most significant applications of Mathematical Programming to an educational problem is its assistance to large urban school districts in establishing a logical and internally consistent schedule, one which results in the highest possible pay for school district personnel assigned to difficult learning environments.

This Mathematical Programming model places emphasis on differentials in the learning or instructional environment. For example, personnel in difficult learning environments received the highest possible salaries within the constraint limitations of the model. Two key elements included in the model are the available amount of school district resources, and assignment of maximum salary weight to positions in difficult learning environments.

The application of the model depends upon identification of personnel by function. Each relevant factor, such as experience, academic

degrees held, becomes a variable in the constraint equations and objective function. The position of principal, for instance, is represented by two equations with an equal number of variables. One equation illustrates the weighted factors and variable less than, or equal to, the highest salary. Another equation represents the variables and weighted factors greater than, or equal to, the lowest salary. Constraint equations were developed for the organizational hierarchy, i.e., superintendent, principal, department head, etc. The optimal district salary schedule for each position is the result of processing the variables according to the mathematical model. The Mathematical Programming model has definite advantages:

(1) It is an internally consistent evaluation scheme valid for all school district functions considered in the model. All agreed-upon factors constituting those functions are taken into consideration.

(2) The model presents to the school district an effective assessment of each individual's relative worth to the school district. This assessment can be reflected in terms of salary.

(3) The model can be used to justify salary increases for school district personnel and could play an important role in wage-salary negotiations with teacher's unions and associations.

(4) The model establishes a salary hierarchy consistent with the objectives of the school district, but it

allows for highly qualified personnel in one function to receive larger salaries than the lowest qualified personnel in a higher function.

(5) The model allows the school district to establish salary priorities (e.g., a school district can pay higher salaries to teachers in difficult teacher situations or to those in high demand, low supply teaching areas, etc.).

(6) The evaluation system encourages participation of teacher groups, administrators, PTA, and the school board in setting the objectives of the school, the functions or job descriptions of its personnel, the establishment of those factors necessary for performance of the particular function, and the ratings of characteristics that constitute each factor.

These are but a few of the many possible examples of the application of Mathematical Programming to educational planning. An application of heuristic programming has been investigated regarding a management problem in school food services. Linear programming techniques were also utilized to check family food expenditures against physiological dietary requirements. Mathematical models have also been developed for the formulation of non-selective, nutritional meals for hospital patients. Above all, application of Mathematical Programming to educational planning has

increased substantially in the past few years.

For the past century the educational system has largely been managed by such general notions as, "Education is a good thing," and, provided it can be afforded, "There cannot be too much of it." Whether the system can continue to be run in this way is doubtful, and it is likely that there will be a desire to manage it more effectively. The educational manager will have to embrace a variety of objectives and he will find it increasingly difficult to neglect any aspect of educational needs. He will, therefore, need better information on the capabilities of students, and on the costs and benefits of education, and he will need better advice and more reliable signals of need from the educational planners. Operations research technique should be quite useful to the educational planner in facing these challenges.

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